

24. (Newly Added) The non-aqueous secondary battery of Claim 5, wherein the compound is selected from the group consisting of AuS and Au<sub>0.5</sub>S.--

### REMARKS

Claims 2-21 and newly added Claims 22-24 are pending in the application. Claims 6-18 and 20 stand withdrawn from consideration. Reconsideration is respectfully requested.

The present invention relates to a nonaqueous secondary battery.

### New Claims

New Claim 22 finds support in the specification at page 13, lines 10-18 of the specification. Further, new Claims 23 and 24 find support in original and active Claim 5 as amended in applicants' response of September 29, 2000. Entry of the amendment into the record is respectfully requested.

### Prior Art Rejection

As is clear on the record the present invention resides in the discovery of a non-aqueous secondary battery which exhibits improved characteristics, wherein the key feature of the battery is the negative electrode made from a select group of metal sulfide compounds. In Claim 19 the active material of the negative electrode is a sulfide compound selected from three different sulfide compounds having formulas (1), (2) or (3), wherein the metal elements A, B, D, E, G, J and M. In Claim 21, the negative electrode is the sulfide of formula (1): A<sub>a</sub>S, wherein A is copper, silver or gold and  $0.4 \leq A \leq 5$ , and further wherein the amount of metal sulfide material in the negative electrode is 75 % by weight to 99.9 % by weight of the

composition of the negative electrode.

Claims 2-5, 19 and 21 stand rejected based on 35 U.S.C. §103 as obvious over Kawakami et al, U.S. Patent 5,702,845. This ground of rejection is respectfully traversed.

The Kawakami et al reference describes secondary batteries which employ lithium. Negative electrodes for the battery are described in the disclosure at column 7, line 61 to column 8, line 12 while positive electrodes are described at column 8, lines 13 et seq. It is noteworthy that none of the negative electrodes described in the reference, none of them are sulfides, and certainly not any of the sulfide materials of the present claims.

The Examiner has asserted on the record that a number of different types of materials are known to be useful as positive and negative electrodes in secondary batteries, and therefore one of skill in the art would find it obvious to use any given material either as a negative electrode or a positive electrode in a battery depending upon the circumstances of the construction of a specific battery. Thus, the Examiner asserts that the sulfides disclosed in Kawakami et al as positive electrode materials would be appreciated by one of skill in the art as being useful in negative electrode construction, thereby leading directly to the present invention. However, Applicant does not concur with this conclusion.

In the first place, it must be noted that the present invention provides a secondary battery having the features described on page 1, lines 9-13, and in particular secondary batteries which exhibit a high voltage, high energy density and excellent charging and discharging characteristics, as well as long cycle life and high reliability. Many kinds of positive electrode active materials, as well as negative electrode active materials, have been proposed in the secondary battery field. Kawakami et al simply disclose some of the active materials which are useful for positive electrodes and some which are useful for negative

electrodes. However, Applicant submits that one of skill in the art reviewing the Kawakami et al disclosure would not be led to the use of the specific negative electrode active materials of the present invention in the construction of a secondary battery. The discovery of the present invention is the specific advantageous effects achieved by the use of the specific sulfide materials identified in the present claims as the negative electrode material. There is nothing in Kawakami et al which would lead the skilled artisan to expect the selection of the specific sulfides of the present invention would give the results Applicant has obtained.

Applicant's position can be appreciated, for example, by considering the working example of Example 1 of the reference. Here it is stated in column 12, lines 22-24 that the cutoff voltages employed during charging and discharging of the battery were set at 4.5 volts and 2.5 volts respectively. However, it must be noted that when the active material subjected to such high voltages is employed as the active material of a negative electrode under low electric potential, irreversible destruction of the structure of the active material may occur. Accordingly, the present invention clearly cannot be reduced just to a pick and choose situation in which one of skill in the art would simply recognize that he could use a sulfide material, disclosed as a positive electrode material, in fact as a negative electrode material in the construction of any secondary battery the skilled artisan would try to construct and expect to achieve the results of the present invention. Given the facts as set forth above with respect to Example 1 of Kawakami et al, it is believed clear that the skilled artisan would not be led to the present invention by Kawakami et al.

The Examiner asserts in the outstanding Office Action that positive and negative electrode designations of the electrodes of an electrochemical device only depend on the mode of the operation of a cell in either a charging or discharging capacity. Applicants

maintain that this position is manifestly incorrect. This fact is shown in the Declaration of record in the case filed August 14, 2001. The Declaration states that when a battery is constructed as described in Example 2 of the application, only differing by using manganese sulfide as the negative electrode material, the resulting cell **did not work** at all in the same charge/discharge test described in Example 1. Manganese sulfide is not a sulfide within the scope of the present claims, but is a preferred metal sulfide as taught by Kawakami et al. Clearly, the improved battery of the present invention can not be obtained by means of using just any metal sulfide as the negative electrode material. Rather, the results of the invention are only achieved with the specific metal sulfides defined in the claims.

Because the Examiner is of the opinion that it is only a matter of choice in battery construction of haphazardly choosing any metal oxide, sulfide or the like as the material for one electrode and any different such material as the material for the other electrode of a battery, there is therefore **nothing unobvious** of choosing the materials for the electrodes of a battery. However, this is clearly refuted by the evidence provided by the Declaration, and, in fact, it is applicants view that the showing of record is sufficient to support their position of the unobviousness of their invention as defined with the submission of any additional comparative examples being unnecessary, because they have shown that a preferred positive electrode material of the reference doesn't function as a negative electrode material in the present invention. This demonstration therefore shows that one of skill in the art could readily predict what particular metal sulfide, oxide or the like would be useful as a negative electrode material in battery construction.

Further with respect to the teachings of Kawakami et al., applicants point out that it is a basic understanding of those of skill in the art that for the types of secondary lithium

batteries disclosed in Kawakami et al, when a cathode material is used in the construction of an anode in the situation where the resulting battery is subjected to high charging and discharging voltages such as in the range of 2.5 to 4.5 volts as described in the reference, it seems that the irreversible portion of the electrode material does increase which leads to reduction in capacity. Accordingly, when an anode material is selected, one of skill must consider the voltage difference to the cathode material, which leads to a conclusion that one of skill can not easily replace the cathode material with that of an anode material. It is therefore believed that the outstanding ground of rejection is obviated and withdrawal of the same is respectfully requested.

Claim 5 stands rejected based on 35 U.S.C. §103(a) as obvious over Kawakami et al, further in view of Kondo et al '104 and Plichta et al, U.S. Patent 5,154,990. This ground of rejection is respectfully traversed.

Applicants' position with respect to Kawakami et al is retained for the reasons stated above. Although Kawakami et al discloses various transition metal sulfides as positive electrode materials, including sulfides of gold, copper and silver, nevertheless, for the reasons stated above, one of skill in the art would not view virtually any transition metal or rare earth metal oxide, sulfide or the like as indiscriminately useful or equivalently useful as either a positive electrode material or a negative electrode material in the construction of non-aqueous secondary batteries. Accordingly, the noteworthy demonstration of the significant utility of certain metal sulfides in the construction of non-aqueous secondary batteries in the present invention, which demonstration is enhanced by the demonstration on the record that MnS, as a negative electrode material, does not result in a functional secondary battery, is believed to support the patentable distinction of the present invention over the Kawakami et al patent.

Kondo et al, although disclosing the use of copper sulfide as an electrode material, not only does so in the construction of a completely different type of electrochemical device such as a capacitor, an electrochromic display or the like, but also is only optionally used in electrode construction with copper metal in the event one desires to prevent over-discharge of a solid electrolyte secondary cell. Thus, not only is the combination of Kondo et al with Kawakami et al difficult because they are directed to unrelated electrochemical devices, but also the disclosure of the optional use of copper sulfide as a component of a copper metal electrode sheet is hardly sufficient to suggest utility of copper sulfide as an effective negative electrode material for a secondary non-aqueous battery.

Finally, the deficiencies of the above discussed references are neither overcome nor improved by Plichta et al. Plichta et al disclose a solid state lithium ion electrochemical system in which CuS is mentioned only as one of a number sulfide/oxide materials which is useful as a lithium intercalating material instead of the primarily useful  $\text{TiS}_2$  as an anode material in a cell using  $\text{LiAlCl}_4$  as the electrolyte. Thus, the reference has nothing to do with non-aqueous secondary batteries, but instead is directed to solid state electrochemical devices which the reference itself distinguishes over non-aqueous secondary batteries at column 3, lines 17-19. Accordingly, the combined prior art references do not suggest the aspect of present claim 5 and withdrawal of the rejection is respectfully requested.

It is now believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

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A handwritten signature in cursive script, appearing to read "F. Oblon", written over a horizontal line.

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**MARKED-UP COPY OF AMENDMENT**

**IN THE CLAIMS**

Please add the following new Claims 22-24.

--22. (Newly Added) The non-aqueous secondary battery of Claim 21, wherein the non-aqueous electrolytic solution contains an organic solvent selected from the group consisting of esters, ethers, 3-substituted-2-oxazolidinones, sulfolane, methylsulfolane, acetonitrile and propionitrile.

23. (Newly Added) The non-aqueous secondary battery of Claim 5, wherein the compound is selected from the group consisting of  $\text{Ag}_2\text{S}$ ,  $\text{Cu}_2\text{S}$ ,  $\text{AuS}$  and  $\text{Au}_{0.5}\text{S}$ .

24. (Newly Added) The non-aqueous secondary battery of Claim 5, wherein the compound is selected from the group consisting of  $\text{AuS}$  and  $\text{Au}_{0.5}\text{S}$ .--